



## 299-E33-21 (A4848)

### Log Data Report

#### Borehole Information:

<b>Borehole:</b> 299-E33-21 (A4848)			<b>Site:</b> 216-B-36 Trench		
<b>Coordinates (WA State Plane)</b>		<b>GWL (ft):</b> 267.7	<b>GWL Date:</b> 2/25/02		
<b>North</b>	<b>East</b>	<b>Drill Date</b>	<b>TOC<sup>2</sup> Elevation</b>	<b>Total Depth (ft)</b>	<b>Type</b>
137,293.1 m	573,474.4 m	Feb. 1957	671.7 ft	284	Cable Tool

#### Casing Information:

<b>Casing Type</b>	<b>Stickup (ft)</b>	<b>Outer Diameter (in.)</b>	<b>Inside Diameter (in.)</b>	<b>Thickness (in.)</b>	<b>Top (ft)</b>	<b>Bottom (ft)</b>
Steel Welded	2.2	8.725	8.0	0.375	0	281

#### Borehole Notes:

The logging engineer measured the stickup using an engineer's tape. Stickup was measured between an engraved "X" on top of the casing and the ground surface. HWIS<sup>3</sup> is the source of the TOC elevation. Total depth and casing bottom (TOC reference) are reported from information provided on the as-built drawing (Ledgerwood 1993) for this borehole. On 02/25/02, the borehole was swabbed, and no contamination was detected. MACTEC-ERS personnel measured groundwater depth.

#### Logging Equipment Information:

<b>Logging System:</b>	Gamma 2A	<b>Type:</b>	SGLS
<b>Calibration Date:</b>	11/01/01	<b>Calibration Reference:</b>	GJO-2002-286-TAR
		<b>Logging Procedure:</b>	MAC-HGLP 1.6.5, Rev. 0

<b>Logging System:</b>	Gamma 1C	<b>Type:</b>	HRLS
<b>Calibration Date:</b>	02/07/02	<b>Calibration Reference:</b>	GJO-2002-309-TAR
		<b>Logging Procedure:</b>	MAC-HGLP 1.6.5, Rev. 0

#### Spectral Gamma Logging System (SGLS) Log Run Information:

<b>Log Run</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
Date	02/26/02	02/27/02	02/28/02	03/04/02	03/04/02	03/05/02
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	2.5	63.0	160.0	284.5	267.0	57.0
Finish Depth (ft)	64.0	161.0	206.5	205.5	281.0	77.0
Count Time (sec)	100	100	100	100	100	100
Live/Real	R	R	R	R	R	R
Shield (Y/N)	N/A <sup>4</sup>	N/A	N/A	N/A	N/A	N/A
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5	0.5
ft/min	N/A	N/A	N/A	N/A	N/A	N/A
Pre-Verification	B0087CAB	B0088CAB	B0089CAB	B0090CAB	B0090CAB	B0091CAB

Log Run	1	2	3	4	5	6
Start File	B0087000	B0088000	B0089000	B0090000	B0090159	B0091000
Finish File	B0087123	B0088196	B0089093	B0090158	B0090187	B0091040
Post-Verification	B0087CAA	B0088CAA	B0089CAA	B0090CAA	B0090CAA	B0092CAA
Depth Return Error (in.)	0	+3	-3	N/A	+2.0	0
Comments	Fine-gain adjustment notes below.	Fine-gain adjustment notes below.	Fine-gain adjustment notes below.	Fine-gain adjustment notes below.	Repeat section. No fine-gain adjustments made.	Repeat section. No fine-gain adjustments made.

### **High Rate Logging System (HRLS) Log Run Information:**

Log Run	1					
Date	03/11/02					
Logging Engineer	Kos					
Start Depth (ft)	11.0					
Finish Depth (ft)	42.0					
Count Time (sec)	300					
Live/Real	R					
Shield (Y/N)	N/A					
MSA Interval (ft)	0.5					
ft/min	N/A					
Pre-Verification	D0023CAB					
Start File	D0023000					
Finish File	D0023062					
Post-Verification	D0023CAA					
Depth Return Error (in.)	-1.25					
Comments	No fine-gain adjustments made.					

### **Logging Operation Notes:**

Zero reference is the top of casing for both the SGLS and HRLS. Logging was performed with a centralizer installed on the both the SGLS and HRLS sondes. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT verifier with SN 082, and pre- and post-survey verification measurements were acquired for the HRLS in the Cs-137 verifier SN 1013.

During SGLS logging, fine gain adjustments were made to maintain the 1460-keV ( $^{40}\text{K}$ ) photopeak at a pre-described channel. During logging run 1, 02/5/02, a fine-gain adjustment was made after file B0087068. During logging run 2, 02/27/02, fine-gain adjustments were made after files B0088082, -123, -158, and -183. During logging run 3, 02/28/02, a fine-gain adjustment was made after file B0089064. On 03/04/02, during logging runs 4 and 5 and also during the pre- and post-surveys, the sonde was enclosed in a plastic bag. Fine-gain adjustments were made after files B0090006, -105, and -153.

The HRLS detector was in the unshielded housing during logging.

## **Analysis Notes:**

<b>Analyst:</b>	Sobczyk	<b>Date:</b>	03/12/02	<b>Reference:</b>	MAC-VZCP 1.7.9, Rev. 2
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SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day. The recorded peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were within five percent of one another at each spectrum's energy line. The acceptance criteria for field verification of the Gamma 2A logging system are in the process of being established; however, evaluation of the spectra indicates that the detector is functioning normally. The post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR.

HRLS pre-run and post-run verification spectra were collected at the beginning and end of the log run. The recorded peak counts per second (cps) for the 662-keV peak were within three percent of one another. The spectra were within the acceptance criteria for the field verification of the Gamma 1C logging system (HRLS). The post-run verification spectrum was used to determine the energy calibration for processing the data using APTEC SUPERVISOR.

Spectra for both the SGLS and HRLS were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in EXCEL (source file: G2ANov1.xls), using parameters determined from analysis of recent calibration data. Zero reference is the top of the casing. On the basis of the As-Built diagram (Lederwood 1993), the casing configuration was assumed to be one string of 8-in. casing with a thickness of 0.322 in. to a log depth of 281 ft. A casing thickness of 0.322 in. was assumed because this thickness would allow direct comparisons with reduced data from previous logging runs and is the published value for ASTM schedule-40 steel pipe (a commonly used casing material at Hanford). A water correction was applied below 267.7 ft to the SGLS data.

Using the SGLS, dead time greater than 40 percent was encountered in the interval from 12.5 to 27.5 ft and at 35 ft, and data from these regions were considered unreliable. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities. This effect is not entirely corrected by the dead time correction, and the extent of error increases with increasing dead time. SGLS dead time corrections were applied when dead time reached 10.5 percent. The HRLS was utilized to obtain data where the SGLS dead time exceeded 40 percent.

## **Log Plot Notes:**

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides ( $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{232}\text{Th}$ ), and man-made radionuclides. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. In addition, comparison log plots of man-made radionuclides are provided to compare the data collected by Westinghouse Hanford Company's Radionuclide Logging System (RLS) and Waste Management Federal Services NW's RLS with SGLS data. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The plots of the repeat logs demonstrate good repeatability of the SGLS data for both the man-made and naturally occurring radionuclides.

## **Results and Interpretations:**

$^{137}\text{Cs}$  was detected almost continuously throughout this borehole.  $^{137}\text{Cs}$  activities exceeded 1,000 pCi/g in the intervals between 12.5 and 44.0 ft. The maximum  $^{137}\text{Cs}$  measured was about 48,000 pCi/g at 14.5 ft. Between 140 and 240 ft, sharp increases in the  $^{137}\text{Cs}$  activity appear to occur at a regular interval of roughly 10 ft. It is speculated that these spikes in  $^{137}\text{Cs}$  may be related to the welded casing joints. In addition,  $^{60}\text{Co}$

contamination was detected, below the recent reported groundwater level (267.8 ft), in the interval from 277.5 to 279.5 ft at concentrations ranging from 0.1 to 0.4 pCi/g.

Recognizable changes in the KUT logs occurred in this borehole. During logging run two (63 to 161 ft), a gradual 1/4 to 1/2 increase in  $^{238}\text{U}$  (based on the 609-keV photopeak) occurs versus a lesser increase based on the 1764-keV photopeak. This change is attributed to the build-up of radon in the borehole during the day. Changes of about 5 pCi/g in apparent  $^{40}\text{K}$  activities occur at about 44, 173, 210, 223, and 279 ft. The increase in  $^{40}\text{K}$  activities at 44 ft probably represents the transition from the coarse-grained sediments of the Hanford H1 to the finer grained sediments of the Hanford H2. The decrease in  $^{40}\text{K}$  activities at 279 ft may represent the top of basalt.

Comparison log plots of data collected in 1992 by Westinghouse Hanford Co. (WHC), in 1997 by Waste Management Federal Services NW, and in 2002 by MACTEC-ERS are included. The 1997 and 1992 concentration data for  $^{60}\text{Co}$  and  $^{137}\text{Cs}$  were decayed to the date of the SGLS logging event in March 2002. On the basis of the near-surface  $^{137}\text{Cs}$  peaks, the SGLS and RLS logs appear to use a different depth reference. Taking into account the differences in depth registration, the apparent  $^{60}\text{Co}$  and  $^{137}\text{Cs}$  concentrations show good agreement between the logging systems. There do not appear to be any significant changes in contaminant profile over the last 10 years.

Gross gamma profiles (attached) from (Fecht et al. 1977) indicate that significant amounts of gamma-emitting contamination were present below 250 ft as early as May 1959. Fecht et al. (1977) present log runs from 5/4/59, 5/17/63, 4/27/70, and 5/4/76. The gamma contamination appears to start at about 80 meters (262 ft) in 1959 versus about 83 meters (273 ft) in the later log runs. Because  $^{60}\text{Co}$  contamination is essentially only detected below groundwater in this borehole, it is speculated that the  $^{60}\text{Co}$  and associated  $^{137}\text{Cs}$  detected at depth may have been transported in the groundwater to this location.

## **References:**

Fecht, K.R., G.V. Last, and K.R. Price, 1977. *Evaluation of Scintillation Probe Profiles From 200 Area Crib Monitoring Wells*, ARH-ST-156, UC-70, Atlantic Richfield Hanford Company, Richland, Washington.

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-East Resource Protection Wells*, WHC-SD-ER-TI-007, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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<sup>1</sup> GWL – groundwater level

<sup>2</sup> TOC – top of casing

<sup>3</sup> HWIS – Hanford Well Information System

<sup>4</sup> N/A – not applicable

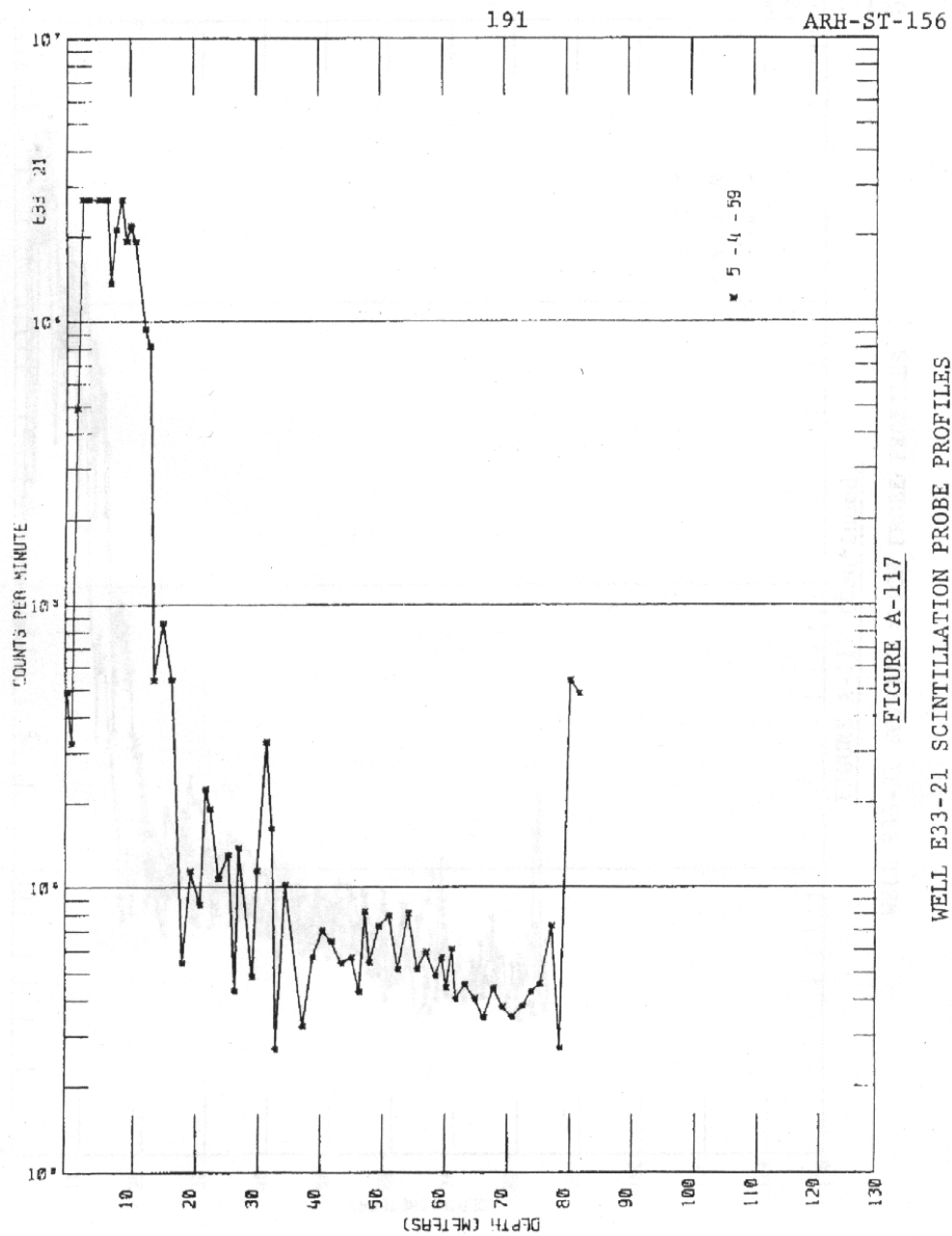


FIGURE A-117  
WELL E33-21 SCINTILLATION PROBE PROFILES

From Fecht et al. (1977)

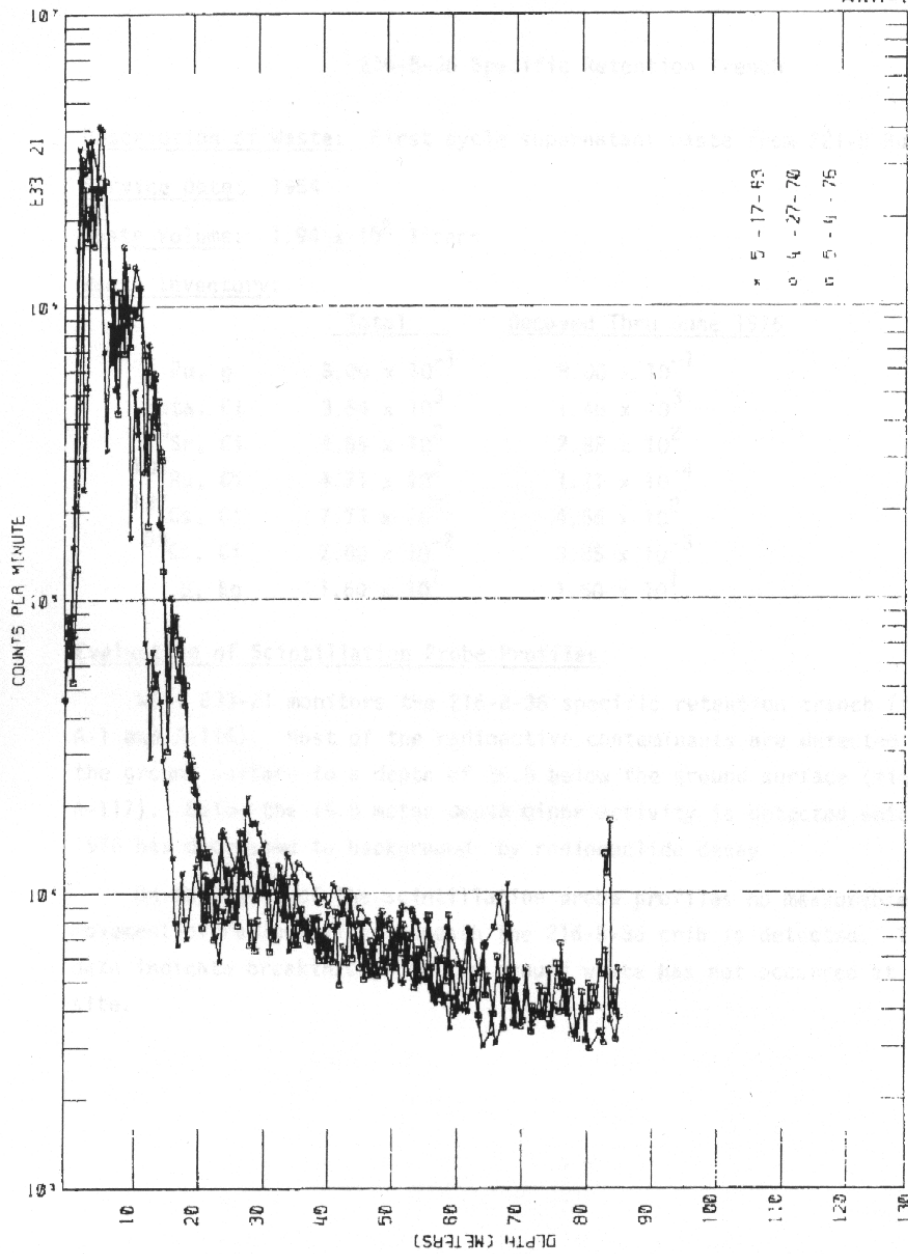
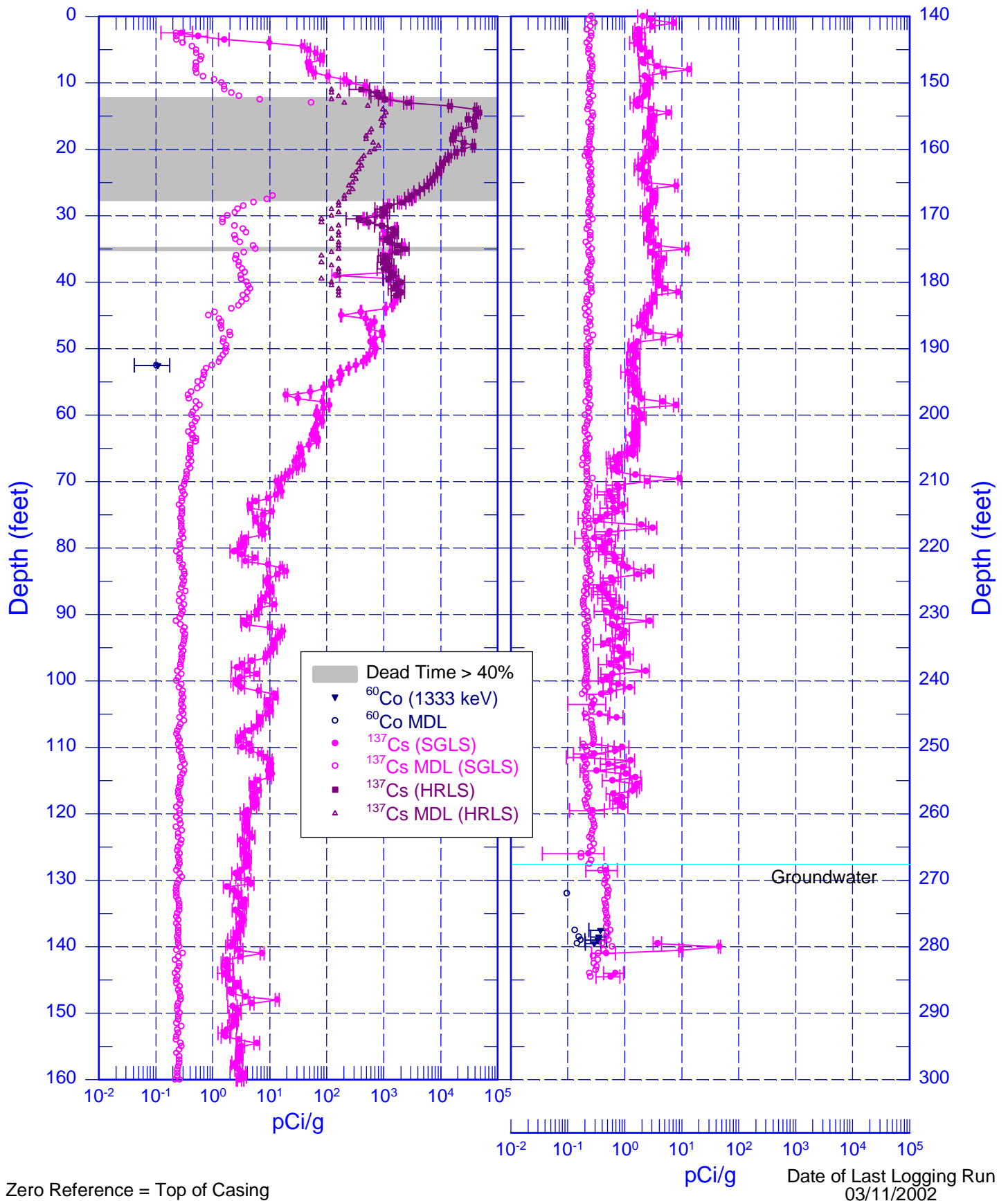


FIGURE A-117 (Continued)  
WELL E33-21 SCINTILLATION PROBE PROFILES

From Fecht et al. (1977)

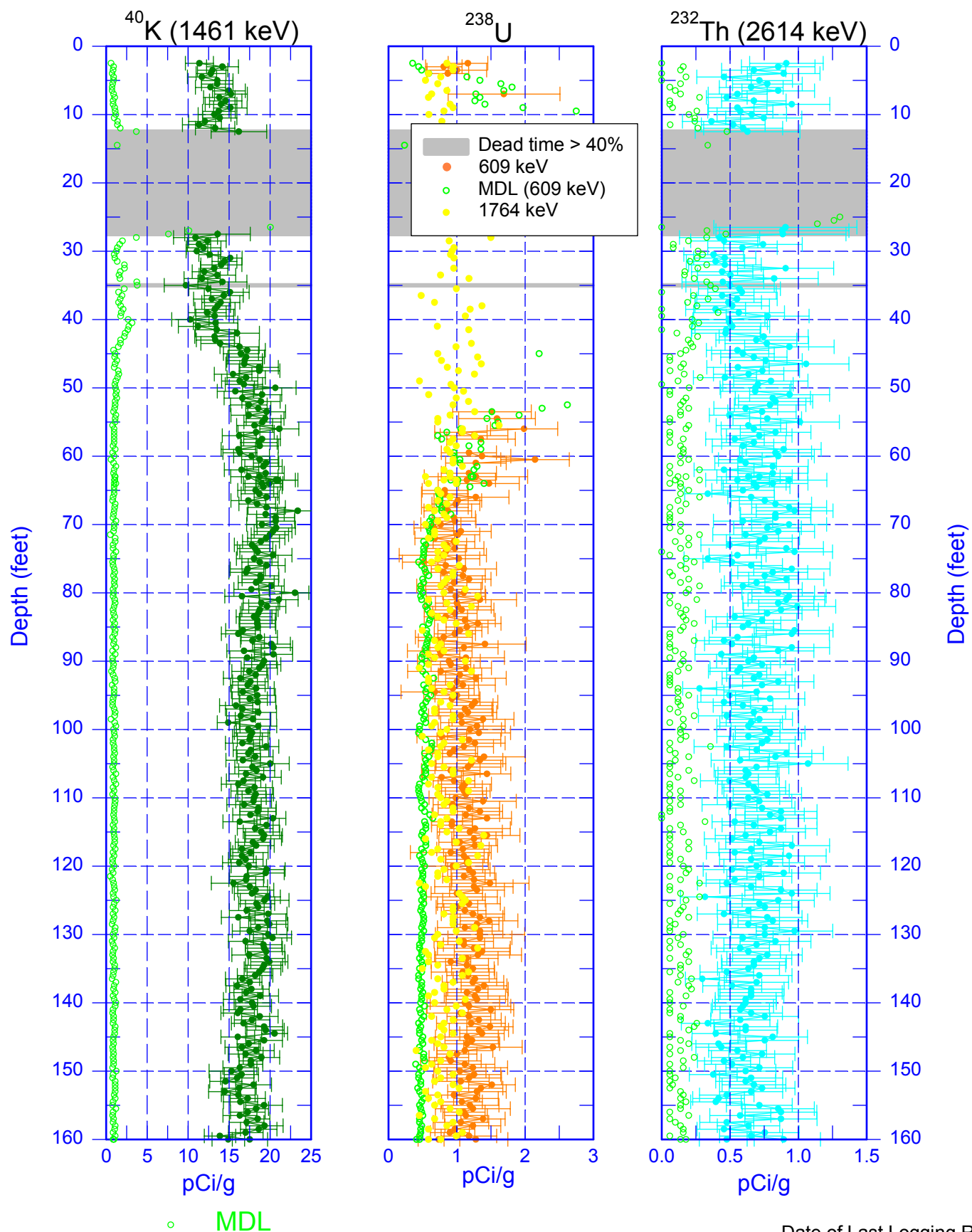
# 299-E33-21 (A4848)

## Man-Made Radionuclides



# 299-E33-21 (A4848)

## Natural Gamma Logs



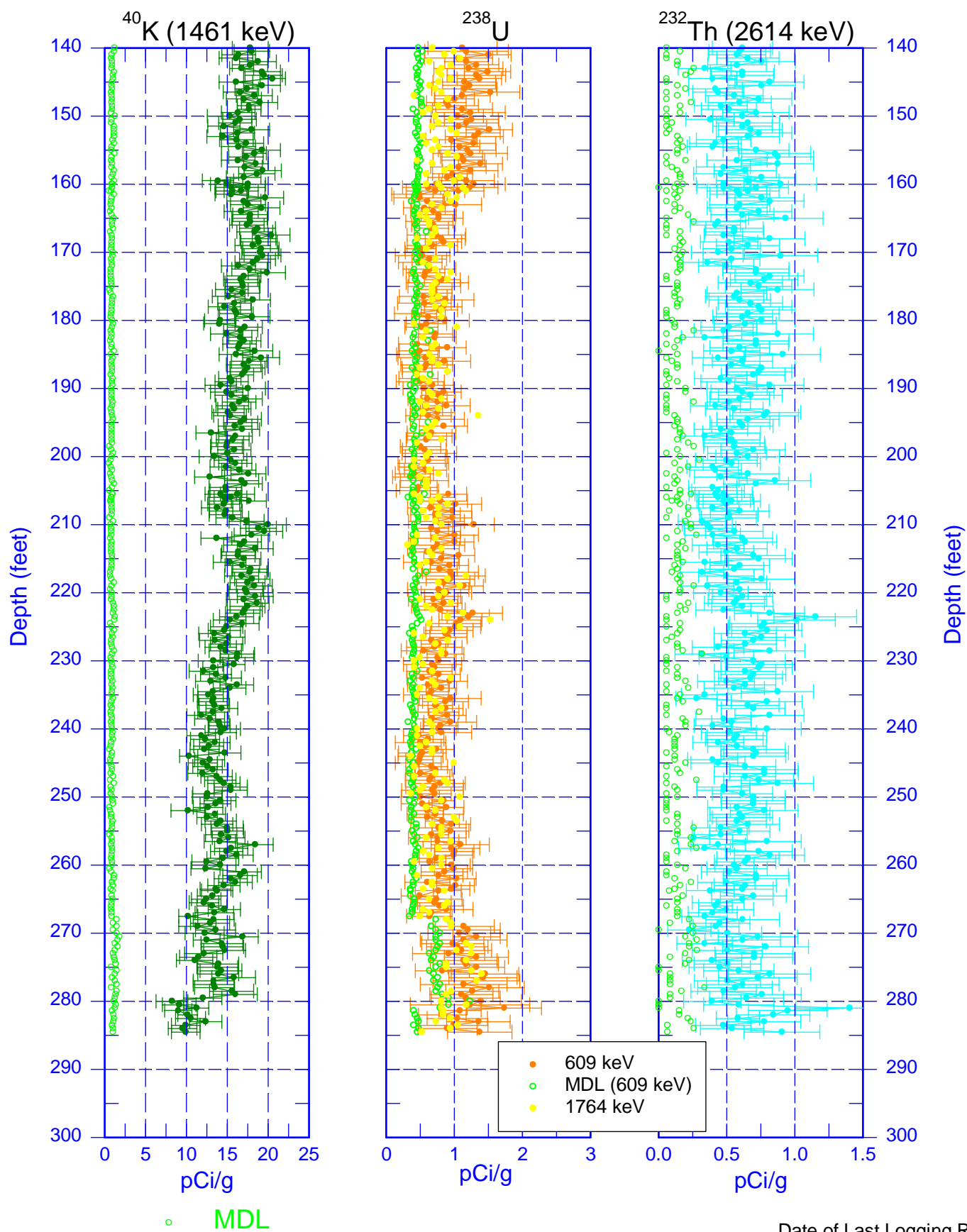
Zero Reference = Top of Casing

Date of Last Logging Run  
03/04/2002



# 299-E33-21 (A4848)

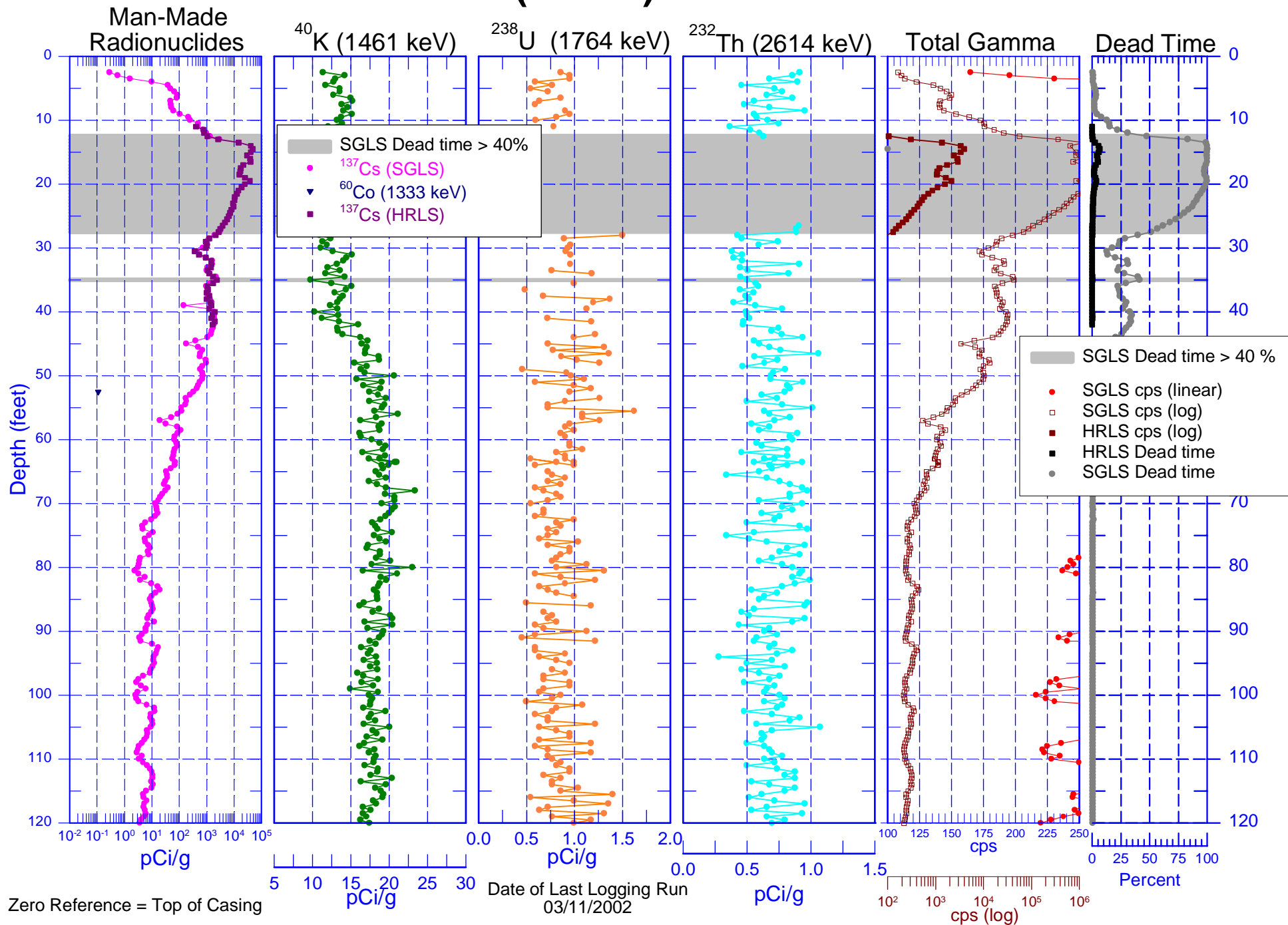
## Natural Gamma Logs



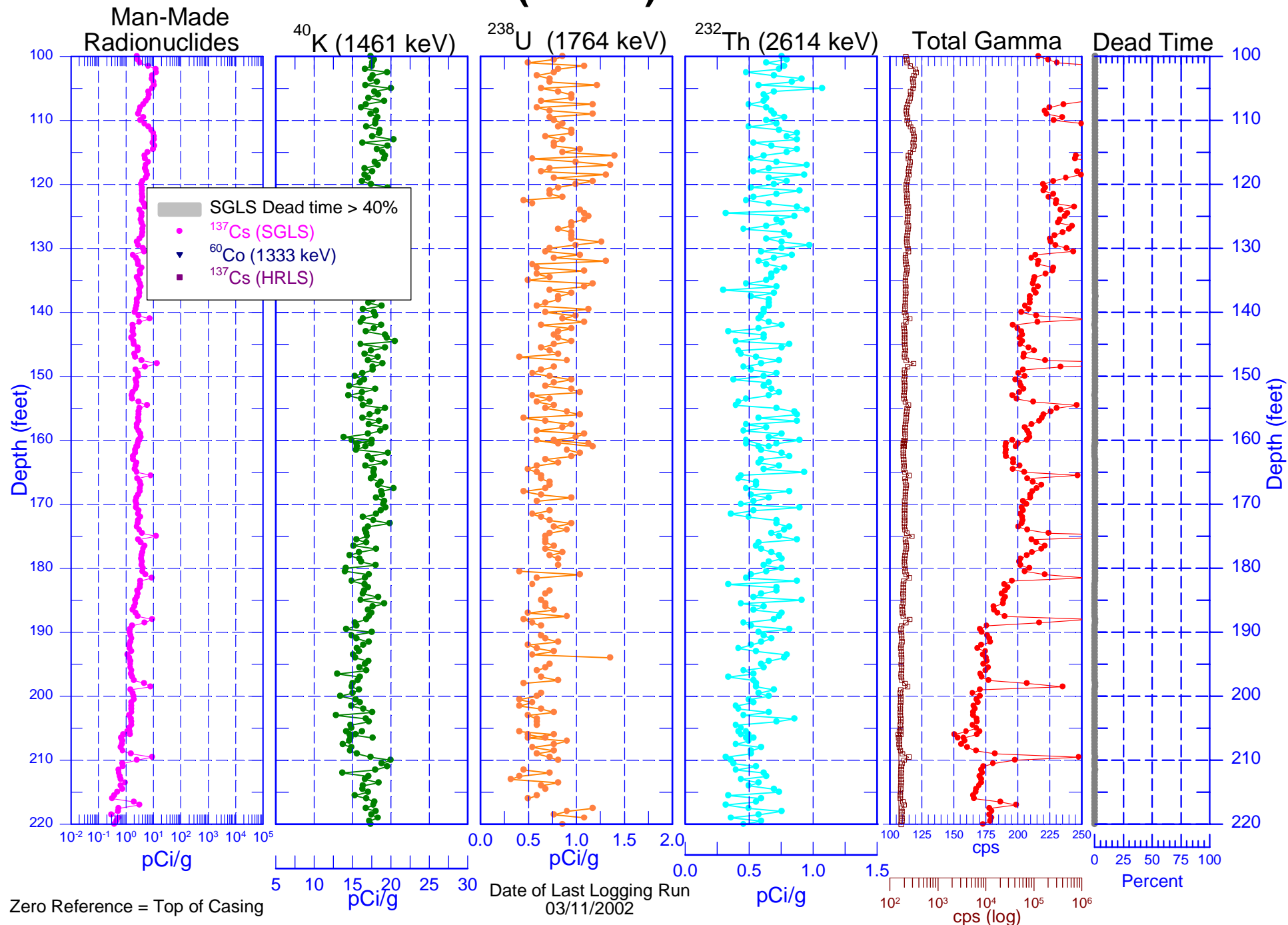
Zero Reference = Top of Casing

Date of Last Logging Run  
03/04/2002

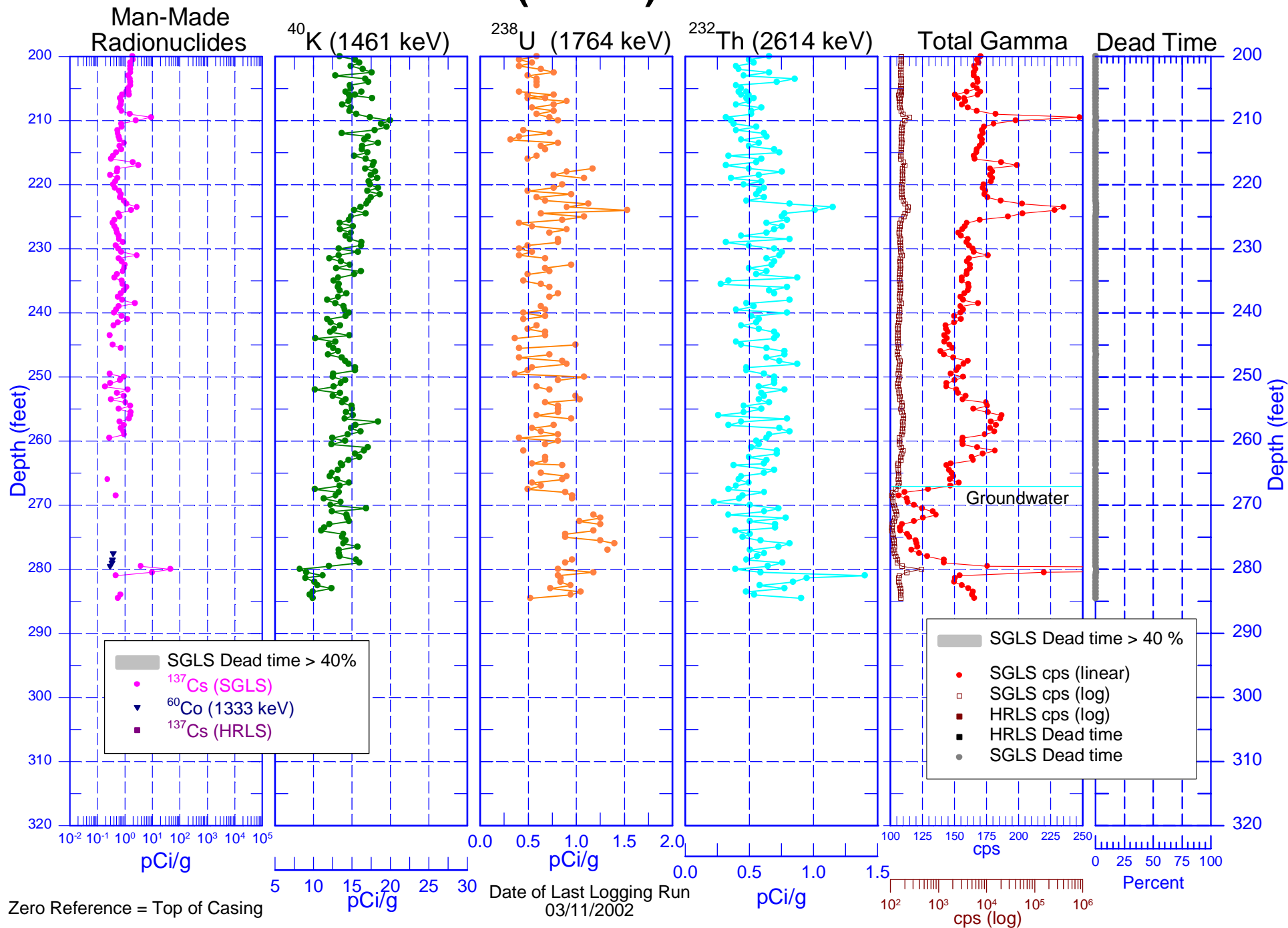
# 299-E33-21 (A4848) Combination Plot



# 299-E33-21 (A4848) Combination Plot

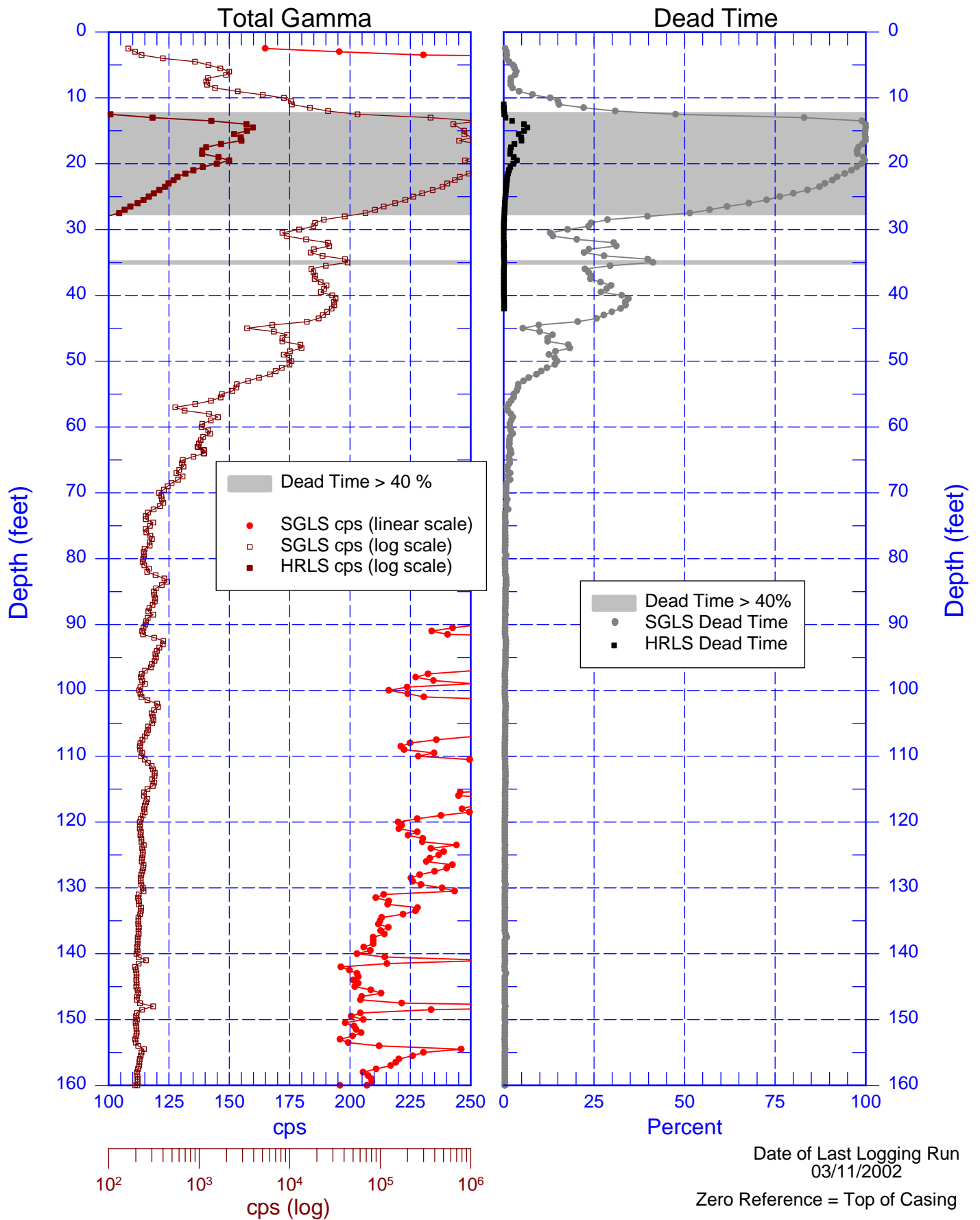


# 299-E33-21 (A4848) Combination Plot



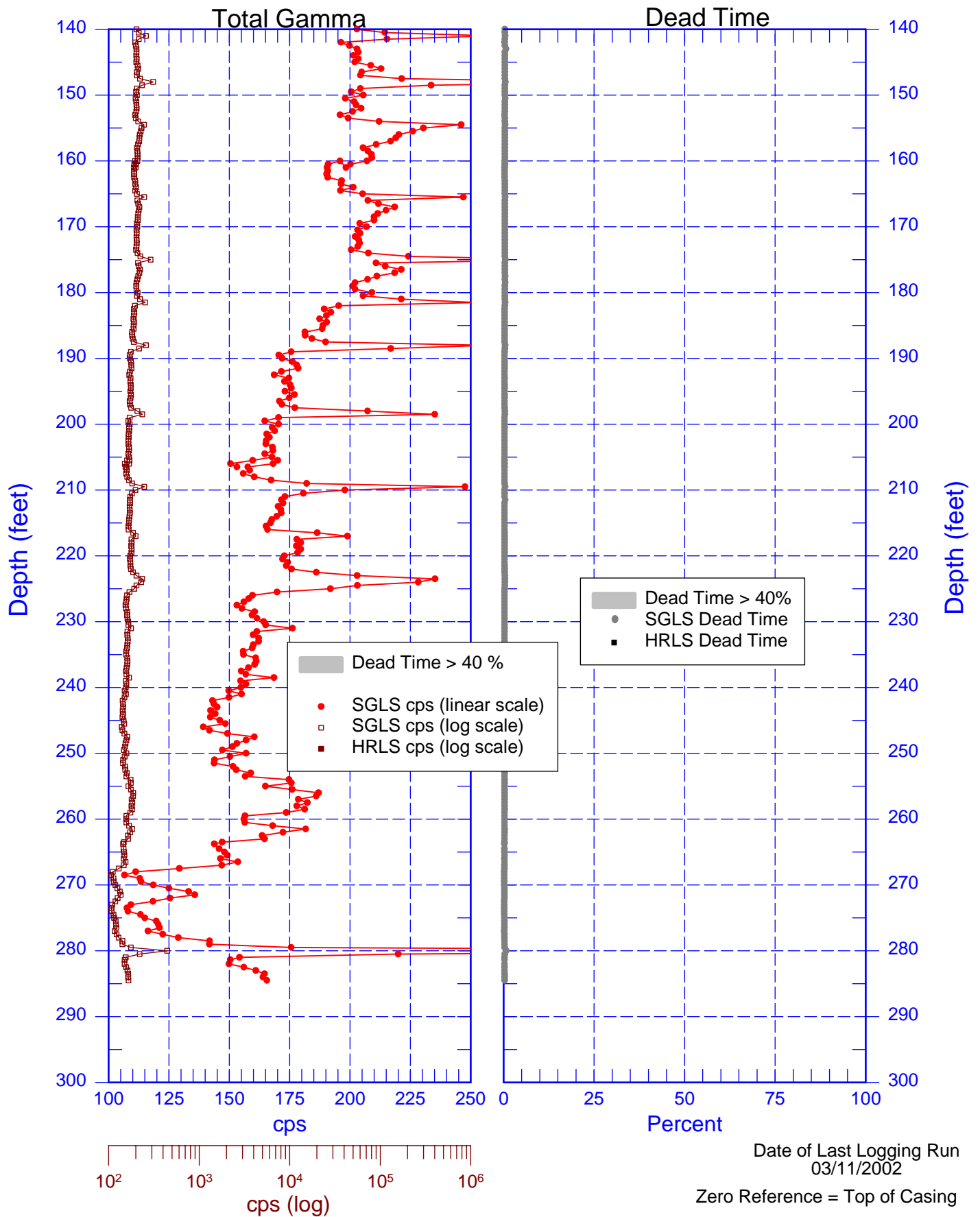
# 299-E33-21 (A4848)

## Total Gamma & Dead Time



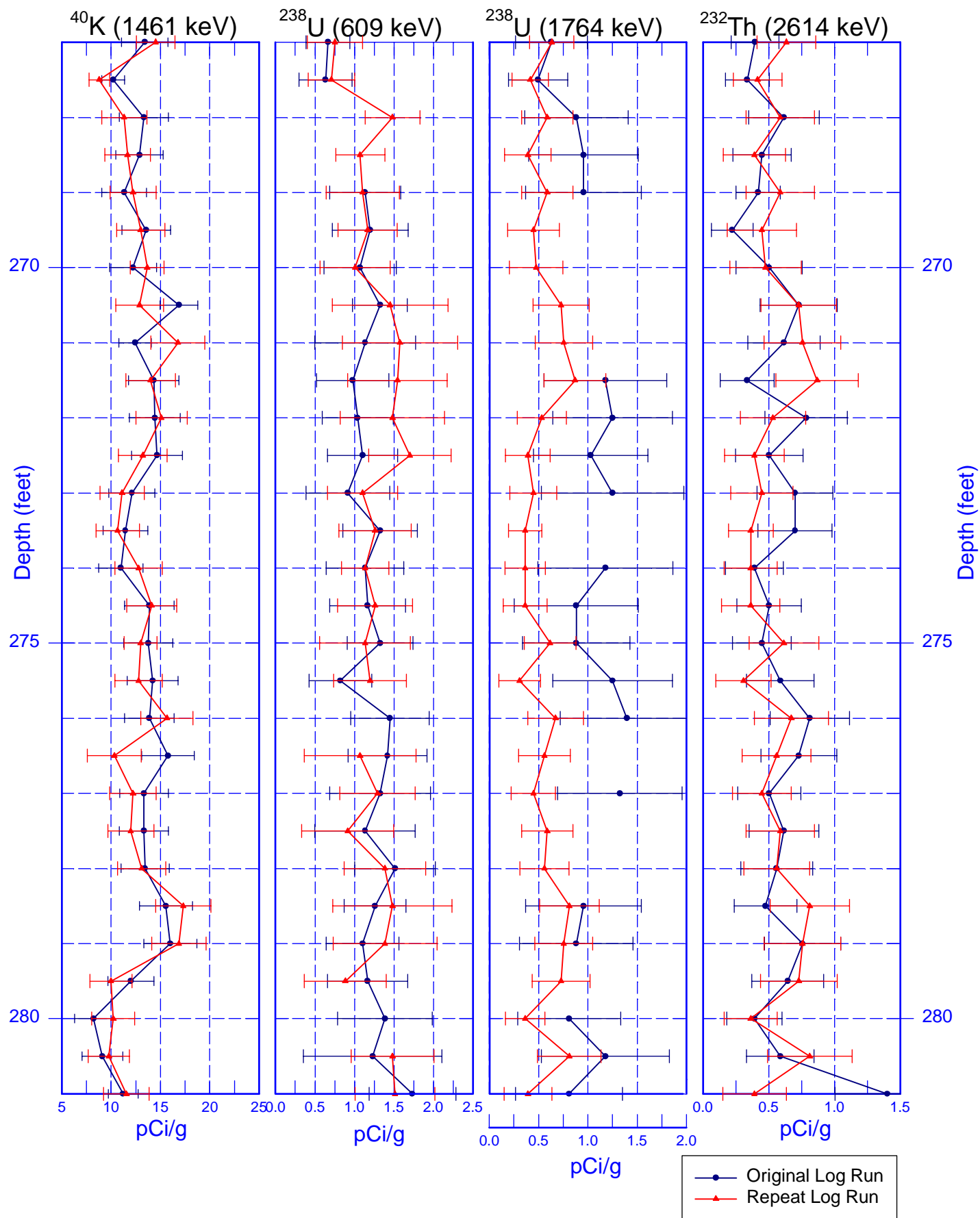
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## Total Gamma & Dead Time



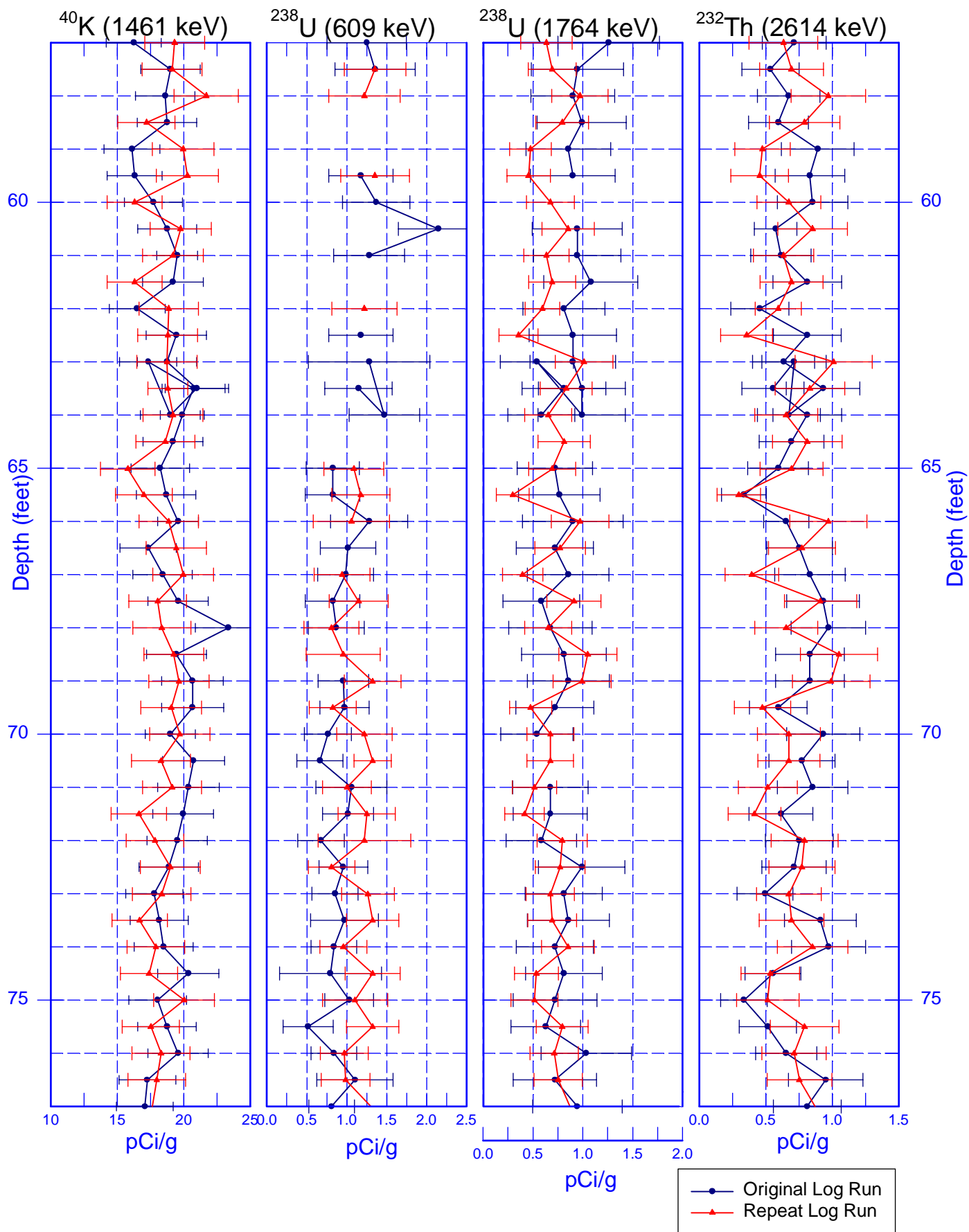
# 299-E33-21 (A4848)

## Rerun of Natural Gamma Logs (267 to 281 ft)



# 299-E33-21 (A4848)

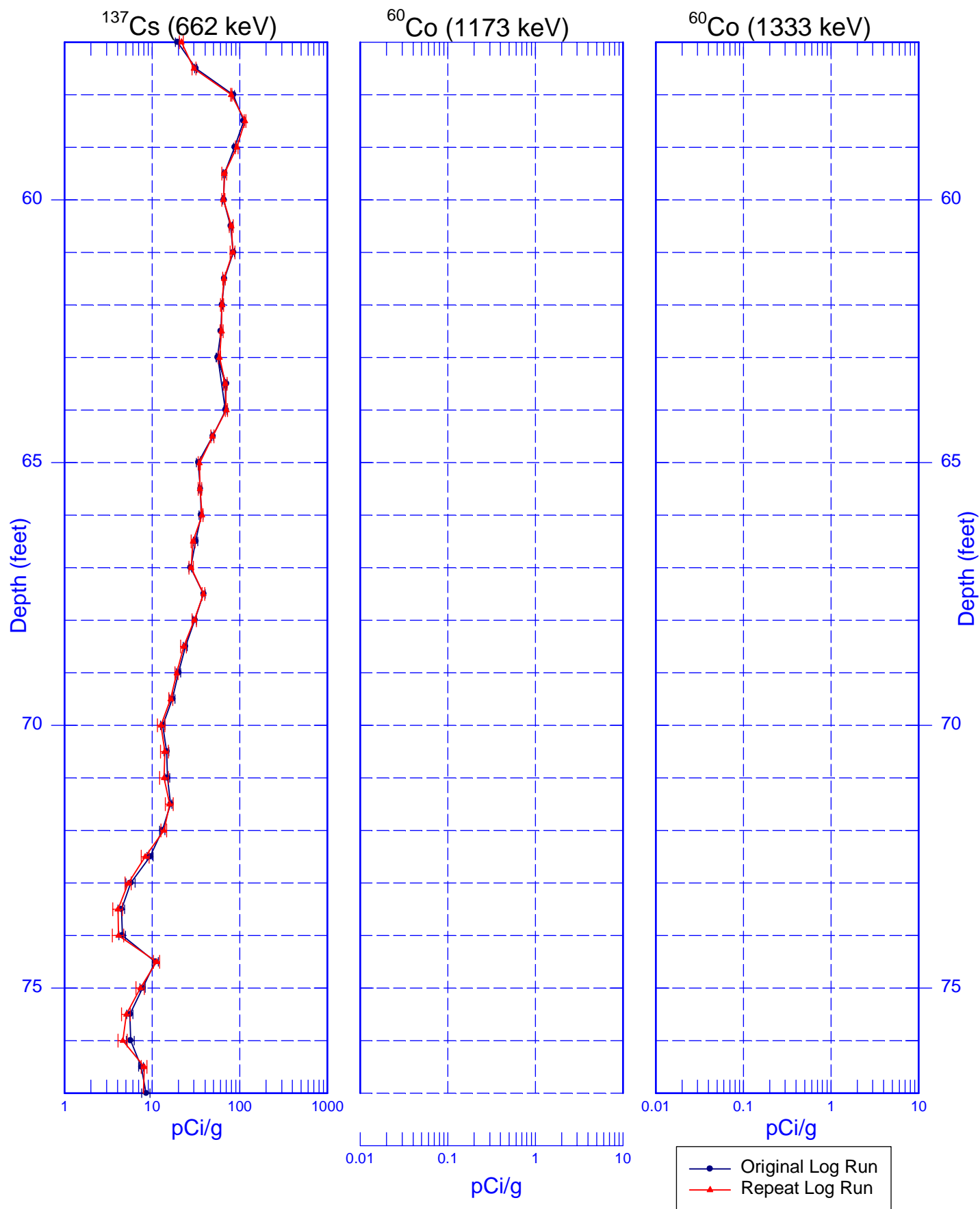
## Rerun of Natural Gamma Logs (57 to 77 ft)





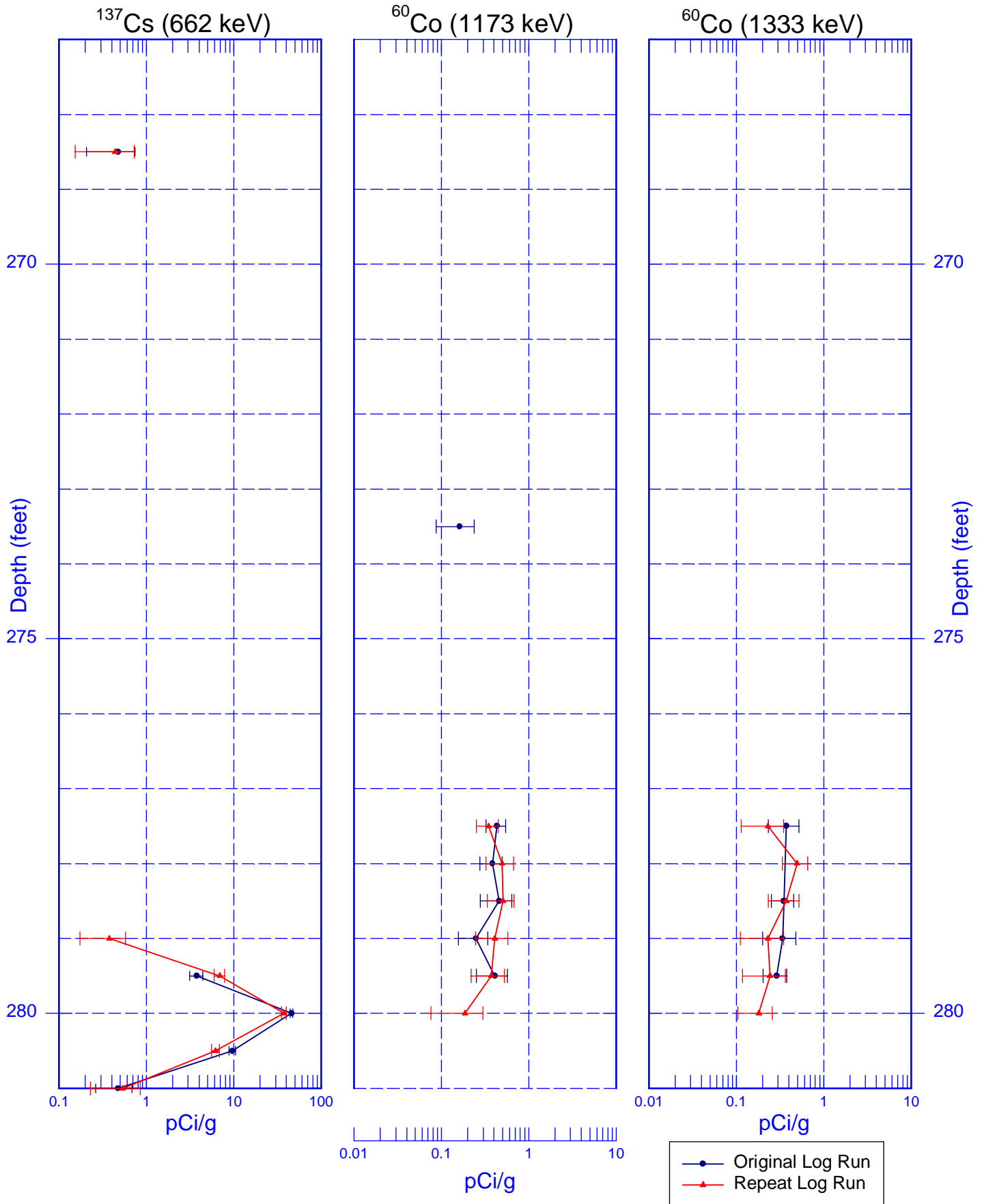
# 299-E33-21 (A4848)

## Rerun of Man-Made Radionuclides (57-77 ft)



# 299-E33-21 (A4848)

## Rerun of Man-Made Radionuclides (267-281 ft)



# 299-E33-21 (A4848)

RLS Data Compared to SGLS & HRLS Data

<sup>137</sup>Cs Decayed to 03/04/2002

